AC 2007-1928: CULTIVATING A SUSTAINABILITY CULTURE IN IRISH SECOND LEVEL SCHOOLS

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Cultivating a Sustainability Culture in Irish Second Level Schools

This paper presents the findings of a research survey given to students and teachers to assess their current understanding of environmental problems (their ecoliteracy), environmental attitudes and to present the resulting strategies to create a culture of sustainability.

State funded institutions, such as secondary schools[*] (see endnote) (high schools) should take the lead in this effort. At the moment the Republic of Ireland, with a population of 4 million, has over 360,000 people in the secondary school system, just over 340,000 of which are students. We simply cannot make real progress towards a sustainability culture unless we teach our young people, our future engineers, scientists and leaders, about the impact they are having on the Earth. While a small group of "green flag" (eco-efficient) schools have applied waste separation and recycling schemes, little is know about the environmental impact of schools which are seen to use high levels of energy and other consumables.

Ireland is one of the countries in the world, with a high ecological footprint, and at 5.4 gha (global hectares per capita) it far exceeds the worldwide average of 2.3 gha. When one considers that the fair Earth share is less than 1.9 gha, it is obvious that we are using much more of the available resources and space than we should, as is the case with most developed countries, we are seriously overusing Earths finite resources. There is an opportunity in education, and in particular engineering and technology education, to promote a culture of sustainability. Currently there is great room for improvement and indeed a moral obligation on us all, to reduce our current impact on the environment. In the words of Vicomte de Chateaubriand, a French diplomat and writer "Forests precede civilization, deserts follow them"

Design of experimental study

Research Questions
A survey of students and teachers in second level schools was designed to answer the following questions:

1. How knowledgeable are students and teachers about environmental problems and solutions
2. What specific issues are best and least understood
3. Does the level of eco-literacy predict attitudes towards the environment?
4. To obtain a snapshot of second level schools thinking to create a baseline before intervention strategies are implemented

A short 9-item questionnaire to test environmental knowledge was designed by taking information from current affairs articles, literature and brochures on environmental activism. Attitudes were also analysed using the "New Ecological Paradigm" (NEP) scale[1]

Initial results have shown that there is great scope for improvement particularly in the area of eco-literacy, which recorded an average score of only 55 percent. Only 2 percent of all females surveyed managed an ecoliteracy score of over 85 percent, and in the entire survey less than 1 percent managed to score full marks. Preliminary

results seem to show a link to ecoliteracy and the level of formal education received. Unlike previous surveys carried out students and teachers were more concerned with issues of a global nature e.g. global warming rather than local issues of garbage or pollution. The majority of respondents had a positive attitude towards the environment and this needs to be channelled further into positive action.

Survey Sample
A sample of students and teachers was taken from nine different Irish second level schools (ISS). This sample took students and teachers from an even mix of Vocational, Secondary and Community Comprehensive Schools. The survey also included two single sex schools (male and female) and both green flag and non-green flag schools. In all twelve schools were attempted with three refusals. The questionnaires were administered in each case by the researcher, who remained present to explain the eco-literacy questionnaire and the NEP scale attitudinal analysis tool and also to answer any questions that may have arisen. The final sample size was 842, of which 777 were students and 65 were teachers ages ranged from 11 years to over 51 years (56% male and 44% female)

Results and Discussions

Environmental Concerns
The first question at the start of the eco-literacy questionnaire asked participants to indicate what they thought was the "single greatest environmental concern facing us today." The Percentage distribution of the replies (total 100%) is shown below.

Table 1. Single greatest environmental concern.

Water Pollution	1.9%
Recycling	4.9%
Ozone Layer	10.5%
Air Pollution	6.2%
Pollution	11.6%
Global Warming	44.9%
Rubbish	11.4%
Other	1.0%
I don't know	2.0%
No Answer Given	5.7%

Note that this answer is heavily skewed towards the issue of global warming, unlike previous surveys that were carried out where the public's perceptions were heavily skewed towards issues that have immediate or local consequences, e.g. garbage disposal or pollution. In prior surveys concerns with issues such as global warming or ozone depletion were mentioned much less often even though the consequences from these are likely to be much greater. People it seems were thinking on a local, personal scale, "what affects me". However individuals now seem to have broadened their horizons and are looking beyond the "me" to the "us".
The frequencies of the replies were checked by age, gender and educational attainment and very little difference was found from the above distribution, global warming always topped the list.

Environmental Knowledge

Respondents were next tested with the remaining nine environmental knowledge questions. Their total scores were converted to a percentage scale (ranging between 0% and 100%). With a mean score of 55.15% and a median of 53.85%, the level of eco-literacy on this test is well below its potential. By conventional academic standards over half of the sample scored less than a D1 grade (50-55%) on the environmental knowledge test. Only one student and one teacher managed to achieve 100%. This indicates the potential for improvement!

However it was noted that the higher a person's levels of formal education, the higher they scored on the eco-literacy quiz.
The average score for a student was 54.7% while the average for a teacher was 60%. Age and maturity may also be a contributory factor here

When the scores are cross-tabulated with gender it can be seen that boys tend to slightly outperform girls but this equalizes out later with increases in age and educational attainment.
The average score for a female student was 53.5%, for a male student the average was 55.6%, whereas both male and female teachers average score was 60%

When compared to the results of a similar evaluation tool given to a group of Third Level University students where the average score was 62%, these findings underscore the fact that the general public's eco-literacy can be improved greatly. In the following paragraphs the results of the eco-literacy questionnaire are analysed, item-by-item.

Symbol recognition

Participants were asked (unaided) to explain what the mobius loop (figure 1.) meant to them, they were then asked to name the Green dot symbol (figure 2.).

On average 91.9% correctly identified that the meaning of the mobius loop was that the product was recycled or had some recycled content. More students than teachers answered this question correctly, 91.6% compared to 87.7%.
However when asked to identify the Green Dot (figure 2) scores were dramatically lower. Only 6.1% answered correctly. In this case though more teachers than students offered a correct answer, 13.8% compared to 5.4% of students.

Figure 1.   Figure 2.

Though one must bear in mind that the recycling symbol has been in use longer than the Green Dot, so participant's awareness is higher for it. However the figure 2 symbol is widely used in EU states.

The Three R's

Participants were asked unaided if they could name the three R's of environmentally friendly behaviour, the percentage of people who mentioned the correct words were:

Table 2. The three R's.

Reduce	89%
Reuse	95%
Recycle	97%

Most people would agree that the level of awareness of these three behaviours is in reverse order. A reduction in demand would be the most direct way of reducing environmental degradation but this is the least frequent response. Recycling, while better than throwing an item in the waste bin is the most energy intensive solution of the three to the damage caused to the environment but is the most common response.

When the responses were broken down and looked at with regards to pupil and teachers we find that pupils outperformed their teachers on naming every one of the three R's. This maybe from environmental education received in primary schools and in CSPE (civic, social and political education) in secondary school, which would not have been in place when the teachers went through the education system themselves.

Table 3. The Three R's, student teacher breakdown.

Three R's	Student	Teacher
Named Reduce	9.6%	21.6%
Didn't name Reduce	90.4%	78.4%
Named Reuse	4.5%	6.2%
Didn't name Reuse	95.5%	93.8%
Named Recycle	2.8%	4.6%
Didn't name Recycle	97.2%	95.4%

What Percentage of all things thought of as waste in an Irish household can be reused?

This question tested respondents eco-literacy by asking what percentage of all things thought of as waste in an Irish household bin could be reused. The researcher administering the questionnaire explained to all participants that this was also meant to include items that could be recycled and or composted. Participants were presented with 5 answer options, outlined below.

Table 4. Percentage of waste that can be reused.

What percentage can be reused?	Student	Teacher
0 – 20%	2.8%	0%
21 – 40%	14.9%	3.1%
41 – 60%	27.9%	26.2%
61 –80% *	39.3%	33.8%
81 – 100%	12.9%	36.9%
Not Answered	2.2%	0%

As may be seen the most common answer of students was 61 – 80%, which was the correct answer, whereas teachers have over estimated the percentage of waste that can be reused. A larger percentage of students than teachers underestimated the amount of waste that can be recycled reused or composted. This may be because in the home, the student's parents might be in charge of waste collection and disposal for their home.

These findings seem to imply that if both students and teachers are made aware of the specific items that can be recycled and composted less will be thrown away and destined for landfill.

What percentage of all things thought of as waste in an Irish household is being recycled?

The table below shows the results of what percentage students and teachers thought was currently being recycled. As we can see both students and teachers have overestimated the percentage that is being recycled.

Table 5. Percentage of waste that is being recycled.

What percentage is being recycled?	Student	Teacher
0 – 20% *	33.8%	38.5%
21 – 40%	43.9%	55.4%
41 – 60%	14%	4.6%
61 –80%	5.4%	1.5%
81 – 100%	1.8%	0%
Not Answered	1%	0%

It is understandable here that teachers might overestimate the percentage that is being recycled due to the fact that they also overestimated the percentage that could be recycled.

Awareness of recycling programmes

Participants were given a list of four items and asked which of the items could not be recycled under most recycling programmes available in Ireland.

Table 6. Recycling programmes awareness.

Item	Student	Teacher
Metal food cans cannot be recycled	11.6%	6.2%
Light bulbs cannot be recycled	80.2%	83.1%
All plastic containers cannot be recycled	11.5%	10.8%
Magazines, catalogues and books cannot be recycled	5.5%	3.1%

As the results show the majority of students and teachers are aware of what can and cannot be recycled, though teachers seem slightly more aware than students. This is again probably due to the fact that in households it is the adults who take care of waste disposal and recycling.

Sources of air pollution

Five answer options were offered to the question "To the best of your knowledge, what is the single largest source of Air Pollution on this planet?" Answers were distributed thus;

Table 7. Single largest source of air pollution

Sources of air pollution	Student	Teacher
Cars	42%	55.4%
Cigarette Smoke	3.3%	1.5%
Industry	33.2%	33.9%
Power Stations	18.9%	4.6%
I don't know	2.2%	3.1%
Not answered	0.4%	1.5%

It is good to see that over half of the teachers surveyed are aware that the automobile is the largest contributor to air pollution. The percentage may be slightly lower with the student population owing to the fact that the majority of them would be below the age to drive.

Global Warming
The questionnaire asked the following open-ended question, "Describe what the "greenhouse effect" means?" They were asked to give a short explanation of two to three lines; answers given were graded on inadequate to excellent scale.

Table 8.Quality of explanations given on greenhouse effect question.

Answer quality	Student	Teacher
Excellent answer	3.2%	9.2%
Adequate answer	17.3%	26.2%
Inadequate answer	48.6%	55.4%
No answer	30.9%	9.2%

Participants were also asked to name a greenhouse gas.

Table 9. Greenhouse gases.

Answer	Student	Teacher
Carbon dioxide	33.8%	49.2%
Methane	7.5%	7.7%
Nitrous Oxide	0.3%	0%
Halocarbons	11.9%	12.3%
Surface Ozone	0.3%	0%
Incorrect answer	15.8%	21.5%
No answer	30.4%	9.2%

The majority of respondents were unable to adequately explain the green house effect. A large percentage of students did not even attempt this question truly a most worrying statistic! Most of the participants giving inadequate or incorrect answers wrote about problems regarding the hole in the ozone layer and mentioned aerosols as the cause of that particular problem. There seemed to be confusion between that and the greenhouse effect.

More teachers gave adequate or excellent answers, it is worrying that this knowledge is not being passed onto students, and one must wonder why?

The most popular green house gas mentioned was carbon dioxide followed by halocarbons (made up of CFC's and PFC's). Carbon dioxide has been on the news and in current affairs magazines for some time so as we can see awareness about this gas is higher from its publicity. Some of the more popular incorrect green house gases mentioned were carbon monoxide, 8.6% of students and 15.4% of teachers named this particular gas. And 0.9% of students and 1.5% of teachers mentioned Sulphur Dioxide.

The results show that the majority of people surveyed have heard about Carbon dioxide as a green house gas but a large majority have little or no knowledge about the actual green house effect.

Overall eco-literacy is an area that can be greatly improved on for both teachers and pupils, as can be seen with the table of scores below.

Table 10. Ecoliteracy scores

Ecoliteracy score	Student	Teacher
0%	0.4%	0.0%
8%	0.3%	1.5%
15%	0.4%	0.0%
23%	1.4%	0.0%
31%	5.9%	1.5%
38%	9.5%	4.6%
46%	17.4%	9.2%
54%	21.5%	26.2%
62%	20.3%	24.6%
69%	14.3%	18.5%
77%	6.2%	7.7%
85%	2.2%	3.1%
92%	0.1%	1.5%
100%	0.1%	1.5%

Both students and teachers are aware of recycling, the majority of both correctly identified that light bulbs cannot be recycled under most of the recycling programmes available in the republic of Ireland.

Although students and teachers seem to be aware of global issues such as global warming they are unable to explain these issues in detail. They demonstrate greater understanding with issues that have an immediate or local concern, e.g. recycling. The majority of respondents answered that they thought that global warming was the single greatest environmental concern facing us today, yet we can see from the question regarding the green house effect that respondents can't clearly explain it.

General awareness can be improved as can general knowledge of environmental problems and issues. We can no longer just think on a local level, we must look to a global level as we are all interconnected in the web of life that is our planet.

To what extent do eco-literacy scores predict attitudes towards the environment? Using student's and teachers overall scores on the eco-literacy quiz as a predictor variable, separate regression analyses was carried out on each of the 15 attitude questions which were answered on a 5 point strongly agree - strongly disagree scale. Because this study is looking at teachers and students separately these two demographic variables were also included as predictors.

10 of the 15 student regression equations were statistically significant and one was approaching significance with a P value of 0.056.
2 of the 15 teacher regression equations were statistically significant and one was approaching significance with a P value of 0.06. These findings are summarized in the table below:

Table 11. Attitudinal regression analyses

Attitude	Predictors	Beta	R^2	Sig.
Humans have the right to modify the natural environment to suit their needs	Ecoliteracy / Student	0.016	0.035	0
When humans interfere with nature, it often produces disastrous consequence	Ecoliteracy / Student	0.006	0.008	0.011
Humans are severely abusing the environment	Ecoliteracy / Student	0.007	0.01	0.005
The Earth has plenty of natural resources; we just need to learn how to develop them	Ecoliteracy / Student	0.008	0.014	0.01
Nature's balance is strong enough to cope with the impact of modern industrial nations	Ecoliteracy / Student	0.012	0.031	0
Despite our special abilities humans are still subject to the laws of nature	Ecoliteracy / Student	0.011	0.03	0
The so-called "ecological crisis" facing humankind has been greatly exaggerated	Ecoliteracy / Student	0.013	0.035	0
Humans were meant to rule over the rest of nature	Ecoliteracy / Student	-0.006	0.005	0.056
The balance of nature is delicate and very easily upset	Ecoliteracy / Student	0.009	0.02	0
Humans will eventually learn enough about nature to be able to control it	Ecoliteracy / Student	0.011	0.02	0
If things continue on their present course, we will soon experience a major ecological catastrophe	Ecoliteracy / Student	0.016	0.047	0
Humans have the right to modify the natural environment to suit their needs	Ecoliteracy / Teacher	-0.020	0.084	0.019
Plants and animals have as much right as humans to exist	Ecoliteracy / Teacher	-0.012	0.055	0.06
Humans were meant to rule over the rest of nature	Ecoliteracy / Teacher	-0.021	0.11	0.007

However from the relatively low R^2 in the third column it is obvious that eco-literacy is only one of many other factors – not captured by this study – which are responsible for these environmental attitudes. For example, students eco-literacy scores predict only 4.7% ($R^2 = 0.047$) of the variation in their agreement/disagreement scores for "If things continue on their present course, we will soon experience a major ecological catastrophe" In this case because the beta coefficient is positive the more eco-literate a person is the more he or she agrees with that statement.

Approaches to cultivating a sustainable culture;

The negative impact of human consumption on the world and its environment has been well documented, (local agenda 21, earth summit Rio de Janeiro). With the ongoing degradation, the local and international policies needed to clean up the Earth have been studied and reported. Even with all of these policies little progress is apparent[2] and the damage to the biosphere in the last twenty years has been greater than the preceding millennia. As nations grow, pressures on the Earth's natural systems and resources intensify. For instance, from 1950 to 1997:

- The use of paper increased six fold,
- The fish catch increased nearly fivefold,
- Grain consumption nearly tripled,
- Fossil fuel burning nearly quadrupled, and

The unfortunate reality is that as the nations continues to expand and grow, the various ecosystems that it depends on are finite and cannot expand accordingly, thus the relationship between the two becomes ever more stressed [3] (Brown 1998: 91, cited in UN DESD 2005)

It is evident that it is difficult to teach environmental literacy without basic literacy. The most educated of nations have the higher per capita rates of consumption and leave the deepest footprints. For example in the U.S.A, 85.2% of persons over 25 years have achieved the level of educational attainment of a high school graduate or more [4] and yet the per capita energy use and waste generation in the U.S.A is one of the highest in the world, the U.S.A has a ecological footprint of approx 9.6 global hectares [5]. More education has not led to sustainability; receiving education at higher levels is not sufficient to attain sustainable societies. We need to look to reorienting existing education.

> The depletion and pollution of the planet is not the work of ignorant people.
> Rather it is largely the result of work by people with BAs, BSs, LLBs, MBAs
> and PhDs[6]   Orr 1994, p. 7

We don't currently teach unsustainability and likewise we can't teach sustainability. Sustainability should emerge impulsively, an unavoidable product of a curriculum that embraces our privileged role in this living world. "If the process of learning is an essential characteristic of culture, then teaching also is a crucial characteristic" [7]. The way subjects are taught and reproduced is itself an important component of cultivating a culture of sustainability.

If we look first at existing teacher training and their own primary and secondary education we can safely say that the majority of teaching staff employed at present would not have received any specialised training or education in the area of sustainability, environmental awareness or ecoliteracy, the curricula in the past did not embrace such issues nor did courses in teacher training institutes.

A great number of teachers would require in-service training to bring them up to speed with such issues. In service is expensive, it leads to classes losing contact time with their teachers, other teachers being required to cover classes for colleagues and it requires time and of course money. It is therefore quite clear that we must reorient pre service teacher education. It should be a module that all trainee teachers undertake no matter their subject specialties. This pre service training is much more time and cost effective and would have the most benefit to trainee teachers at a formative time in their teaching career.

School management would also need to partake of an awareness programme, training and education in this area. In order for a sustainability culture to be fully embraced into schools it requires the understanding and backing of those in management. True change requires all people involved in the school to work together in the one direction. If only small pockets of people work in isolation towards a goal of

sustainability then true change will not happen and any progress they might have been made will certainly fade away. If all sectors of the school are involved then everybody moves towards being sustainable.

Students also need to be involved on the development from the start and must be given a sense of ownership of the process. In this case there is a process of co-learning and a sense of empowerment. This could be achieved by the setting up of a student committee and actively involving students in any decision-making. Students need to develop informed values and attitudes towards the environment so that they can learn to make the correct choices in their lives, in school and beyond. "By learning throughout our lives we equip ourselves to choose most advantageously as the future unfold[8]"(Scott and Gough 2003 p.147)

Students and teachers must work together to achieve true change and to make a difference both in their lives and the lives of future generations.
Schools should establish a set of baseline data, so that they can chart progress against it. A group of students, teachers, support staff and indeed parents and members of the community can work together to calculate the schools ecological footprint, there are many software packages available that can take the hard work out of the calculation e.g. "eco'tude[9]" (online calculator). Footprinting can really help students understanding of sustainability by helping them to appreciate the impact that they are having on the planet and what this impact could mean to future generations.

Once a baseline is established schools can set and monitor targets. Setting targets will help pupils see the end goal as a number of small steps that can be easily achieved. Holding celebrations when significant targets are reached will have an encouraging impact; these celebrations will involve the whole school and again bring positive publicity and awareness to the issue of sustainability.

Each school could set up their own action programme, which is suited to their school. An action programme should be part of a whole school process and implemented over a period of years not months. Students will need to see that the teachers, support staff and senior management are serious and committed to finding solutions and applying new strategies and supporting real changes for the long term.
The definition of a strategy itself is, a long term plan of action designed to achieve a particular goal. It is not something that can be achieved overnight; time and energy must be put in to reap the rewards. It is worth bearing in mind that each and every person on the planet, not just ourselves as individuals, will feel the impact of our success or failure. Teachers, parents and students must all start thinking about environmental and sustainability issues. Eating your greens isn't enough anymore; you've got to live green.
Further work will include using
- Existing software to determine the ecological footprint of Irish second level schools,
- Devise sustainability auditing tools suitable for use in schools,
- To reduce schools environmental impact,
- Bringing the experimental school groups to ISO1400 standard,
- Create a suitable training programme for school management, which will foster a sustainability culture in second level schools,
- Administer survey to school administrators and mangers.

Endnote

*Students in Ireland attend secondary school for five/six years. Irish students start second level education at the age of thirteen, though in some case's students may start at twelve. Students take a three-year course that leads to a state examination called the Junior Certificate, where they undertake examinations in approximately twelve subjects, with a core group of Irish, English, Maths, Science, History and Geography. After the Junior Certificate that students may have the option of taking an extra transition year before they start a two-year course that will lead to their final second level examination, the Leaving Certificate, at approximately age eighteen. For the Leaving Certificate students generally take seven subjects, with their best six results of the terminal exam counting towards College/University entry. Again students take a core of Irish, English, Maths and four other electives. The USA second level students equivalent would be grades eight through to twelve, or junior and senior high school.

References:

(1) Dunlap,R.E., Van Liere,K.D., Mertig, A.G., & Jones, R.E. (2000) *Measuring endorsement of the New Ecological Paradigm: A revised NEP scale*. Journal of Social Issues, 56 (3), 425-442

(2) E. Goldsmith, *Twenty years on: The message remains the same* The ecologist 20 (1990) 122-124

(3) United Nations Decade of Education for sustainable development 2005 – 2014 International implementation scheme draft January 2005

(4) U.S census bureau (2007) *USA statistics in brief--education* [online], available: http://www.census.gov/compendia/statab/files/edu.html [accessed 10 January 2007].

(5) *Living Planet Report 2006,* p.14 WWF – world wide fund for nature

(6) *Orr, D. 1994,* Earth in Mind: on Education, Environment and the Human Prospect. *Washington, D.C.: Island Press*

(7) Washington State University, virtual campus, the learning commons (1995), *A baseline definition of culture* [online], available: http://www.wsu.edu:8001/vcwsu/commons/topics/culture/culture-definition.html [accessed 11 January 2007].

(8) *Scott, William and Stephen Gough. 2003.* Sustainable Development and Learning: framing the issues. *London: RoutledgeFalmer.*

(9) Powerhouse, science + design (2007), *Eco'tude* [online], available: http://www.powerhousemuseum.com/ecotude/ [accessed 15 January 2007]